stomach, to constitute the gastric juice, the free hydrochloric acid, acid phosphates and chlorides, and the albuminoid bodies and disintegrated tissue (*the pepsine* ?) to act in the liquefaction of food.

II. "Contributions to the History of Explosive Agents." By F. A. Abel, F.R.S., For. Sec. C. S. Received March 9, 1868.

(Abstract.)

The degree of rapidity with which an explosive substance undergoes metamorphosis, as also the nature and results of such change, are, in the greater number of instances, susceptible of several modifications by variation of the circumstances under which the conditions essential to chemical change are fulfilled.

Excellent illustrations of the modes by which such modifications may be brought about are furnished by gun-cotton, which may be made to burn very slowly, almost without flame, to inflame with great rapidity, but without development of great explosive force, or to exercise a violent destructive action, according as the mode of applying heat, the circumstances attending such application of heat, and the mechanical condition of the explosive agent, are modified*. The character of explosion and the mechanical force developed, within given periods, by the metamorphosis of explosive mixtures such as gunpowder, is similarly subject to modifications; and even the most violent explosive compounds known (the mercuric and silver fulminates, and the chloride and iodide of nitrogen) behave in very different ways, under the operation of heat or other disturbing influences, according to the circumstances which attend the metamorphosis of the explosive agent (*e.g.* the position of the source of heat with reference to the mass of the substance to be exploded, or the extent of initial resistance opposed to the escape of the products of explosion).

Some new and striking illustrations have been obtained of the susceptibility to modification in explosive action possessed by these substances.

The product of the action of nitric acid upon glycerine, known as nitroglycerine or glonoine, which bears some resemblance to chloride of nitrogen in its power of sudden explosion, requires the fulfilment of special conditions for the development of its explosive force. Its explosion by the simple application of heat can only be accomplished if the source of heat be applied, for a protracted period, in such a way that chemical decomposition is established in some portion of the mass, and is favoured by the continued application of heat to that part. Under these circumstances, the chemical change proceeds with very rapidly accelerating violence, and the sudden transformation, into gaseous products, of the heated portion eventually results, a transformation which is instantly communicated

* Proceedings of the Royal Society, vol. xiii. pp. 205 *et seq.*

throughout the mass of nitroglycerine, so that confinement of the substance is not necessary to develope its full explosive force. This result can be obtained more expeditiously and with greater certainty by exposing the substance to the concussive action of a detonation produced by the ignition of a small quantity of fulminating powder, closely confined and placed in contact with, or proximity to, the nitroglycerine.

The development of the violent explosive action of nitroglycerine, freely exposed to air, through the agency of a detonation, was regarded until recently as a peculiarity of that substance; it is now demonstrated that gun-cotton and other explosive compounds and mixtures do not necessarily require confinement for the full development of their explosive force, but that this result is attainable (and very readily in some instances, especially in the case of gun-cotton) by means similar to those applied in the case of nitroglycerine.

The manner in which a detonation operates in determining the violent explosion of gun-cotton, nitroglycerine, &c., has been made the subject of careful investigation. It is demonstrated experimentally that the result cannot be ascribed to the direct operation of the heat developed by the chemical changes of the charge of detonating material used as the exploding agent. An experimental comparison of the mechanical force exerted by different explosive compounds, and by the same compound employed in different ways, has shown that the remarkable power possessed by the explosion of small quantities of certain bodies (the mercuric and silver-fulminates) to accomplish the detonation of gun-cotton, while comparatively very large quantities of other highly explosive agents are incapable of producing that result, is generally accounted for satisfactorily by the difference in the amount of force suddenly brought to bear in the different instances upon some portion of the mass operated upon. Most generally, therefore, the degree of facility with which the detonation of a substance will develope similar change in a neighbouring explosive substance may be regarded as proportionate to the amount of force developed within the shortest period of time by that detonation, the latter being, in fact, analogous in its operation to that of a blow from a hammer, or of the impact of a projectile.

Several remarkable results of an exceptional character have been obtained, which indicate that the development of explosive force under the circumstances referred to is not always simply ascribable to the sudden operation of mechanical force. These were especially observed in the course of a comparison of the conditions essential to the detonation of gun-cotton and of nitroglycerine by means of particular explosive agents (chloride of nitrogen, &c.), as well as in an examination into the effects produced upon each other by the detonation of those two substances.

The explanation offered of these exceptional results is to the effect that the vibrations attendant upon a particular explosion, if synchronous with those which would result from the explosion of a neighbouring substance

in a state of high chemical tension, will, by their tendency to develope those vibrations, either determine the explosion of that substance, or at any rate greatly aid the disturbing effect of mechanical force suddenly applied, while, in the instance of another explosion, which developes vibratory impulses of different character, the mechanical force applied through its agency has to operate with little or no aid, greater force, or a more powerful detonation, being therefore required in the latter instance to accomplish the same result.

Instances of the apparently simultaneous explosion of numerous distinct and even somewhat widely separated masses of explosive substances (such as simultaneous explosions in several distinct buildings at powder-mills) do not unfrequently occur, in which the generation of a disruptive impulse by the first or initiative explosion, which is communicated with extreme rapidity to contiguous masses of the same nature, appears much more likely to be the operating cause, than that such simultaneous explosions should be brought about by the direct operation of heat and mechanical force.

A practical examination has been instituted into the influence which the explosion of gun-cotton through the agency of a detonation, exercises upon the nature of its metamorphosis, upon the character and effects of its explosion, and upon the uses to which gun-cotton is susceptible of application.

III. "Results of Magnetical Observations made at Ascension Island, Latitude 7° 55′ 20″ South, Longitude 14° 25′ 30″ West, from July 1863 to March 1866." By Lieut. Rokeby, R.M. Reduced by G. M. Whipple, Magnetical Assistant at the Kew Observatory. Communicated by B. Stewart, LL.D. Received March 11, 1869.

On leaving England for Ascension Island in May 1862, Lieut. Rokeby was supplied by General Sabine with the following instruments for the purpose of making observations of magnetical variation and intensity, viz.:—

A portable declinometer and unifilar for absolute observations of declination and horizontal intensity, a Barrow's dip-circle (No. 24), a differential declinometer, and a differential bifilar.

The differential declinometer and the bifilar were erected at George Town, Ascension, in August 1862, and bihorary observations commenced; but in consequence of instability in the supports of the instruments, caused probably by the shifting of the volcanic cinders which formed the ground at the observing-station, the observations made exhibit frequent discrepancies. The whole of the bifilar observations, and all the differential declinometer observations prior to June 1864, have therefore been omitted from the present discussion.